Outbreak of *Cryptosporidium parvum* linked to a farm which had an open day in Warwick Bridge, Carlisle

Tracey Wood - Senior Health Protection Practitioner
Cumbria & Lancashire HPU

Identification of the Outbreak

1st case notified to HPU on 8th May 2009, child admitted to hospital with broken arm had onset of D&V on the 6th May. Reported child had been to a farm with school the week before.

14th May three cases of cryptosporidium notified to Carlisle Environmental Health, all had visited same farm on the 30th April 2009.

Investigations by EHOs identified 8 primary schools in Carlisle attended open day at a local farm on 30th April. Approx 360 school children had visited the farm. No further events planned.

Approx 100 of the children had been absent with sickness and diarrhoea!

Background - Cryptosporidium

sporozoites leaving an oocyst in the small intestine.

Protozoan parasite
4-6µm in size
Life cycle occurs in the gut: no multiplication in environment
Oocyst stage shed in faeces: robust and highly resistant
Shed in high densities by infected humans / neonatal farmed animals
Even ONE oocyst can cause acute gastroenteritis (cryptosporidiosis)

Cryptosporidiosis

Main symptoms:

- Watery diarrhoea of acute onset
- Abdominal pain
- Nausea and/or vomiting
- Low grade fever and loss of appetite
- Symptoms often relapse

Incubation period (linked to dose) range 1-12 days

Duration 12.7 days may be up to a month

T-cell immunodeficiencies may become chronic, more severe disease

Cryptosporidium



In animals:

•*C.Parvum* affects neonates: calves, lambs, kids

•High numbers oocysts shed in faeces both symptomatic & asymptomatic

•Cryptosporidium less common in older animals, more likely to carry species non pathogenic to humans

Transmission:

•Oocysts immediately infective when shed

•Survive in moist environments for months

•Infectious dose is low

•Transmission of *C.parvum* from animals to humans well documented outbreaks linked to open farms, residential outdoor centres, educational training farms

Outbreak Control Team

An OCT established and met on the 15th May.

Membership: CLHPU, Cumbria PCT, Carlisle CC Environmental Health, Cumbria CC Children's Services, Microbiology CIC, VLA, HPA food, water & environmental lab, Cryptosporidium reference laboratory.

Objectives of OCT:

–Institute appropriate control measures
–Document the extent of the outbreak
–Identify the likely source of the outbreak
–Identify factors responsible for the outbreak

News & Star

CARLISLE CHILDREN STRUCK DOWN BY BUG AFTER FARM VISITS

By Phil Coleman

Last updated 09:53, Saturday, 16 May 2009

Cumbrian health chiefs have issued urgent advice about farm visits after confirming that four children were stricken by a stomach bug carried by cattle and lambs.

Sure kids can visit the farm, but should they be hugging the cows?

POSTED: MAY 17TH, 2009 - 6:19PM BY DOUG POWELL

Yesterday I wrote about a bunch of schoolkids in Carlisle , U.K. that have been stricken wit cryptosporidium, apparently related to so called-educational visits to nearby farms.

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News & Star **News**

CUMBRIAN HEALTH CHIEFS FEAR SPREAD OF CHILDREN'S FARM BUG

By Phil Coleman

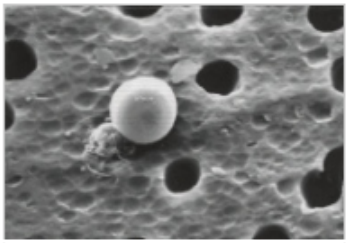
Last updated 11:56, Thursday, 21 May 2009

Health chiefs have issued fresh advice to parents in Carlisle amid fears that a bug associated with farm visits may be spreading among primary school children.

Five children from the city have been confirmed has having been stricken by the cryptosporidium bug, which causes sickness and diarrhoea.

The Health Protection Agency (HPA) is investigating and is working on the theory that they may have caught the bug following a recent farm visit.

One of the schools worst affected was Stanwix Primary, where 20 children who went on a recent



Infection: The cryptosporidium bug, which causes sickness and diarrhoea, has been confirmed in five children in Carlisle, who

Case finding

In the initial stages of the investigation case definitions were agreed:

POSSIBLE – An individual who had visited the farm in Warwick Bridge for an open day on the 30th April 2009 and who had reported symptoms associated with gastro-intestinal illness, including nausea, vomiting, abdominal pain or diarrhoea.

CONFIRMED – as above and *Cryptosporidium sp*. isolated from a faecal sample.

Case finding

Schools requested provide lists of pupils & staff that had been absent with sickness and / or diarrhoea following the farm visit.

CLHPU wrote to GPs in the Carlisle area requesting consider *Cryptosporidium* in children presenting with sickness & diarrhoea.

Letter sent to parents & guardians, providing info about crypto, infection control and exclusion advice. Advising to contact GP if children had symptoms.

Sampling strategy – target all possible cases. Carlisle EH posted out sample pots & boxes with Ilog no. EHOs arranged collection and transportation to CIC lab.

Control Measures

Aim of preventing secondary spread, Cumbria County Council Children's services, instructed all effected schools to:

•Enhance environmental cleaning, especially increasing frequency of toilet cleaning.

•Supervision of hand washing after children visited toilet and before eating.

•Enforcement of exclusion criteria i.e. free of symptoms for at least 48 hours before returning to school.

Activities on the Farm Visit

A questionnaire for teachers involved in farm visit was sent out via Cumbria Children's Services.

Organised by Cumberland Agricultural Society

2 sessions AM (9.30 – 12.10) and PM (12.10 – 15.10)

Activities included:

–Petting and feeding goats
–Milking a cow
–Petting calves
–Touching new born chicks
–Watching eggs hatch through an incubator
–Looking at silage, hedgerows, machinery, vegetables.
–Taking part in an auction.

Reported alcohol hand gel used instead of washing hands. **Gel was available after petting calves but not after petting and feeding goats.**

Stages of Outbreak Investigation

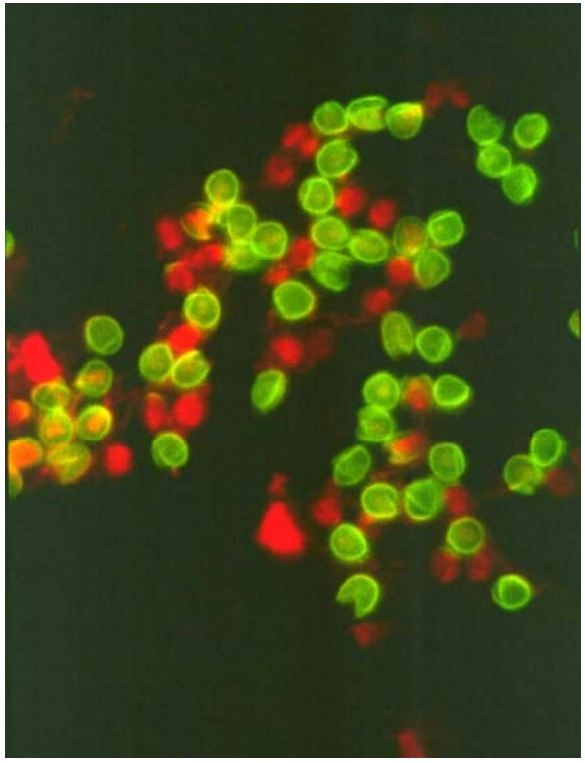
Environmental Investigation

Veterinary Investigation

Microbiological Investigation

Epidemiological Investigation

Environmental investigation – EHD & VLA



Exposures

Children had contact with :-

–7-10 day old calves (in a hurdle pen)

–Kid goats and a nanny goat in another pen

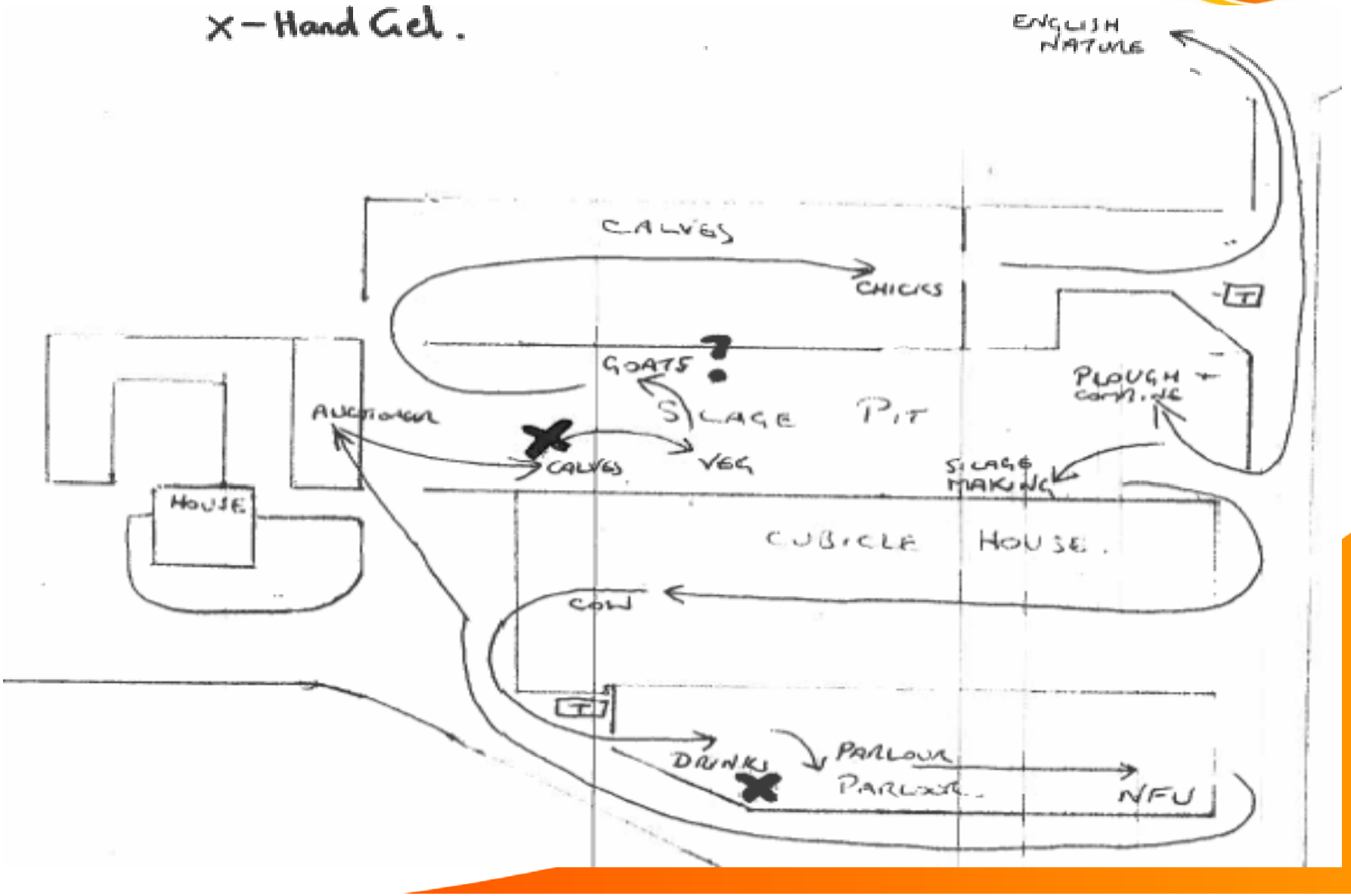
–A “quiet” cow which was milked

They ate on the premises after contact with the animals.

Hand cleansing was with gel only.

The organisers had installed alcoholic hand gels on the premises as a hygiene measure but were unaware of HSE advice & guidance currently available for farms wishing to hold open days

Plan of circuit



Alcohol hand gel

Antec Instant Hand Sanitizer kills 99.9% of most germs in 15 seconds (1 in 1000 survive)

Some hand gels are 70% ethanol

In *C.parvum* studies with 70% ethanol, contact times of 20 mins found no marked reduction in infectivity. *(Barbee et al., 1999; Weir et al., 2002)*

Inadequate for *Cryptosporidium* infection control purposes.

Veterinary Investigation

VLA carried out an advisory/investigatory visit in collaboration with the EHO and private vet.

Environmental samples and cattle faeces submitted to VLA Penrith.

Goats had been brought in from another farm for the open day and returned to Lancashire. Farm visited and goat faeces submitted to VLA Preston.

Animal testing results

Calves which were petted by the children, 1/3 tested positive *(+ 1000 to 10,000 oocysts/g)*

I calf with diarrhoea positive *(++++ 70,0000 to 2 million/g)*

Goat (kids) samples (collected from pens) 7/19 positive. *(++ 10,000 to 150,000/g)*

Nanny goat was negative

Floor sample nr calf pens positive *(+++ 150,000 to 700,000/g)*

Microbiological Investigation

Human specimens submitted to microbiology @ CIC for routine microscopy

All samples both positive and negative then submitted to the Cryptosporidium reference laboratory, for *Cryptosporidium*, Immuno-fluorescence Antibody Test (IFAT) and then *Cryptosporidium sp*. by PCR.

Further subtyping on 21 of human positives (at CRU) and all the animal positives (at VLA Weybridge).

Microbiological Investigation

Results

54 school children sampled

37 positive *C.parvum* (14 llaA17G1R1 subtype)

Additional 4 samples confirmed as *C.parvum* which were secondary cases within families. So there were **41 confirmed cases in total.**

(Included 28 IFAT positive samples that were negative by local diagnostic tests.)

All positive animal samples identified by PCR as *C.parvum.*

Subtyping showed the only the calf samples were subtype IIaA17G1R1, goat samples didn't amplify.

Suggesting calves may have been source of outbreak……???

Health Protection Agency

Epidemiological Investigation

Case Definition

The case definition was symptom based. For the purposes of analysis a case was defined as:

Case

An individual who had visited the farm in Warwick Bridge for an open day on the 30th April 2009 and who had reported symptoms associated with gastro-intestinal illness, including nausea, vomiting, abdominal pain or diarrhoea between 30th April 2009 and 15th May 2009.

Control

An individual that had visited the farm in Warwick Bridge for an open day on 30th April 2009 and had not reported any illness or symptoms between 30th April 2009 and 15th May 2009.

Analysis

Information from the completed questionnaires was entered onto a database and was then analysed using EpiData Analysis version 2.1.

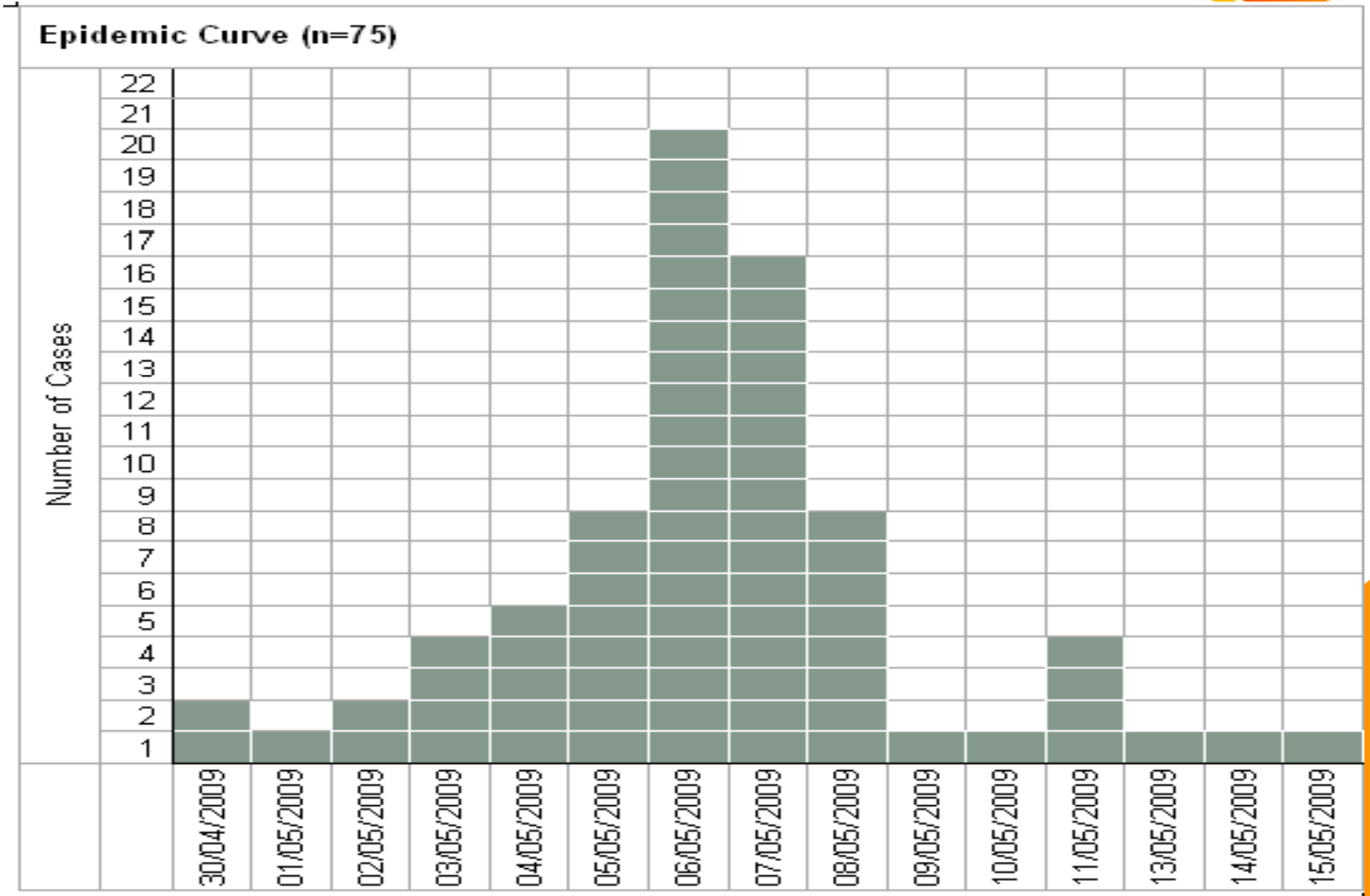
Epidemiological Investigation

382 children attended the farm during its open day. Questionnaires were sent to all children on the visit and 158 (41%) were returned.

Data from 138 questionnaires was used in the final analysis.

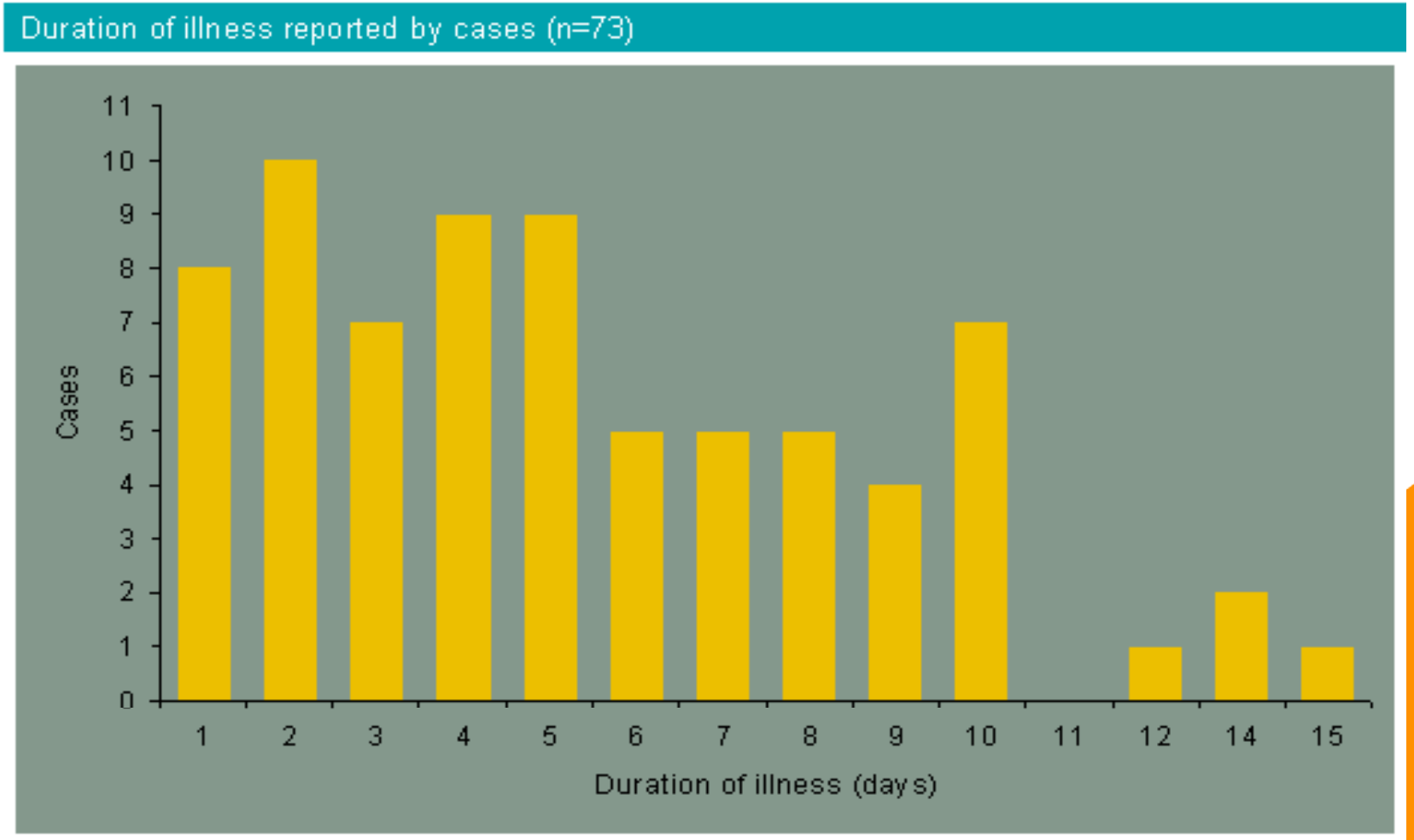
Study Population, cases and controls				
Children visiting Farm	Questionnaires received	Cases	Controls	Not meeting case or control definition
382	158	75	63	20

Descriptive epidemiology



Duration of illness

Between 1 and 15 days. Average (mean) duration of illness was 5 days.
3 (4%) of all reported cases admitted to hospital

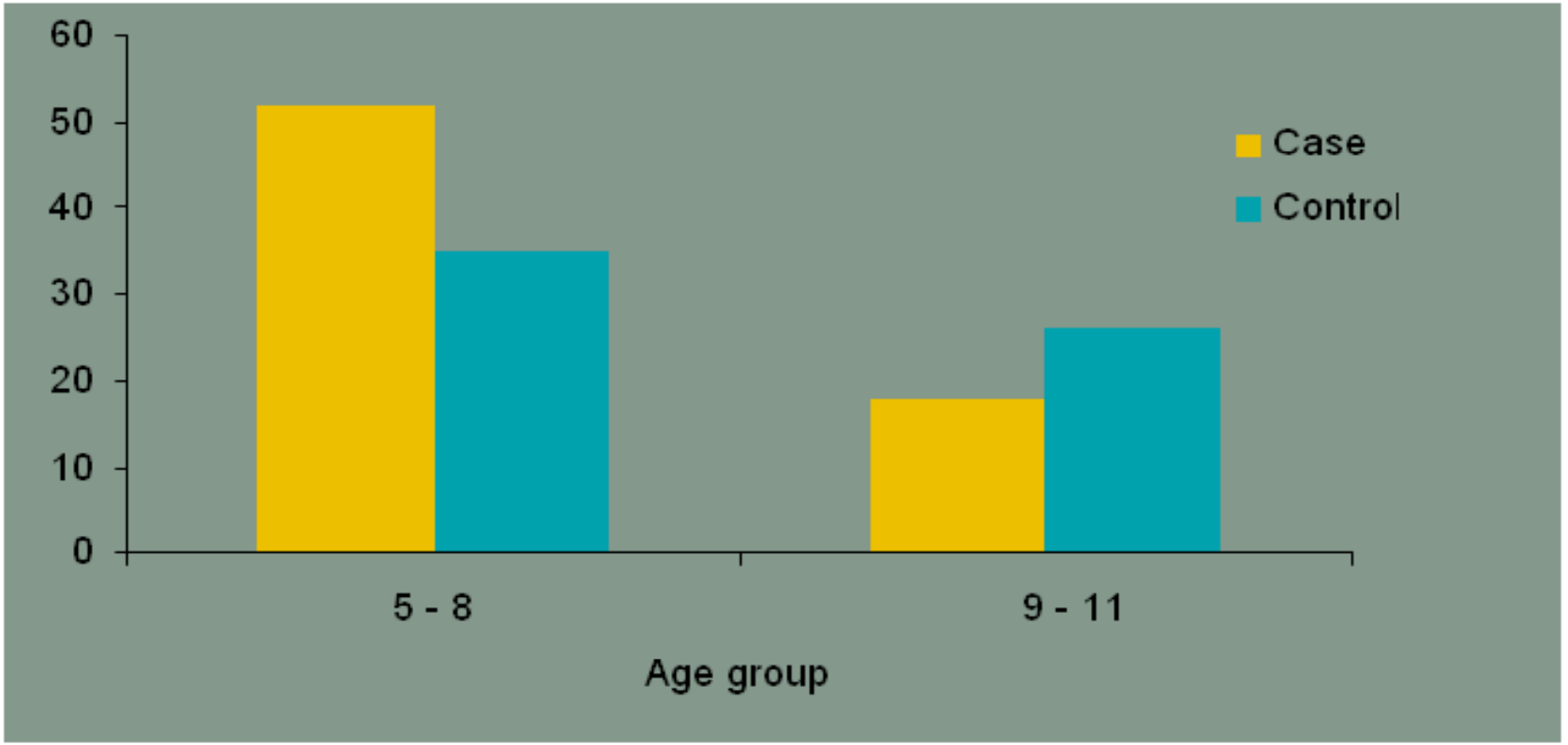


Symptoms

Table 3. Symptoms reported by cases (n=75)		
Symptom	**Number reporting**	**(%)**
Diarrhoea	64	85
Blood in stools	1	1
Abdominal Pain	70	93
Feeling feverish	36	48
Vomiting	39	52
Nausea	51	68
Appetite Loss	51	68
Headache/Muscle ache	36	48

Age

Figure 2. Cases and controls by age group (n=131)



Univariate Analysis

Various risk factors considered, varied from activities farm visitors took part in during the open day to other risk factors such as having pets and going swimming.

Table 4. Univariate analysis of "farm visit" risk factors on 30th April 2009

		Case		Non Case				
	N	Exposed	Non exposed	Exposed	Non exposed	Odds ratio	(95% CI)	p-value
Petted and fed goats	131	65	6	46	14	3.27	(1.08-11.18)	0.0183
Milked a cow	136	61	13	49	13	1.24	(0.48-3.21)	0.6155
Handled baby chicks	127	44	26	25	32	2.15	(1.00-4.70)	0.0325
Petted calves	126	54	14	41	17	1.59	(0.65-3.94)	0.2572
Ate cheese and/or biscuits	132	59	10	53	10	1.11	(0.38-3.24)	0.8252
Drank the milk	133	58	14	44	17	1.59	(0.66-3.91)	0.2522
Drank the water	125	12	55	9	49	1.19	(0.42-3.48)	0.7212
Took own food/drink	126	8	61	7	50	0.94	(0.28-3.26)	0.9057
Washed hands before eating	117	54	9	49	5	0.61	(0.15-2.21)	0.4037

Univariate analysis of other risk factors

Univariate Analysis

Univariate analysis of other risk factors								
		Case		Non Case				
	N	Exposed	Non exposed	Exposed	Non exposed	Odds ratio	(95% CI)	p-value
Sex (baseline=female)	137	40	34	35	28	0.94	(0.45-1.95)	0.8603
Age: 5-8 yrs or 9 - 11 yrs (baseline=5-8 yrs)	131	52	18	35	26	2.13	(0.96-4.81)	0.041
Swimming	133	26	46	19	42	1.25	(0.57-2.76)	0.5466
Paddling	106	1	58	0	47	-inf	(0.02- inf)	0.3698
Other	102	2	55	0	45	-inf	(0.15- inf)	0.2044
Had pets	136	41	33	32	30	1.16	(0.56-2.42)	0.6587
Child usually bit nails/sucked thumbs	135	23	50	30	32	0.49	(0.23-1.05)	0.0453

The univariate analysis showed statistically significant association ($p<0.05$) with illness in three of the risk factors analysed. These were petting and feeding goats, handling baby chicks and age group.

Multivariate Analysis

Risk factors with statistically significant association with illness were stratified to reduce confounding. The only risk factor to be independently associated with the outbreak was petting and feeding goats.

Risk factor multivariate analysis using stratification			
Risk Factor	**OR**	**(95% CI)**	**P-value**
Petting and feeding goats adjusted for Handling baby chicks and Age group	4.58	(1.36-18.44)	0.002
Age group adjusted for Petting and feeding goats and Handling baby chicks	1.69	(0.64-4.47)	0.075
Handling baby chicks adjusted for Age group and Petting and feeding goats	1.93	(0.77-4.92)	0.12

Goat typing results

Based on results of epi analysis, goat samples re-tested at Crypto ref unit.

C.Parvum was confirmed in **2** of the goat samples. Subtype sequence obtainable for 1 and was IIaA17G1R1, the outbreak 'strain'.

VLA Ref.	Faecal state	Age	Pen No.	VLA IFAT Result	CRU IMS PCR SSU DNA sequence	CRU IMS PCR GP60 sequence
3	Pultaceous	Kid	1	2+	*C.xiaoi*	Did not amplify
4	Diarrhoea	Kid	1	1+	*C.parvum*	IIaA17G1R1
8	Pellet	Kid	1	2+	Did not amplify	Did not amplify
13	Pellet	Kid	2	2+	*C.xiaoi*	Did not amplify
16	Pellet	Kid	2	2+	*C.xiaoi*	Did not amplify
17	Pellet	Kid	2	1+	*C.parvum*	Did not amplify
18	Pellet	Kid	2	1+	*C.xiaoi*	Did not amplify

Conclusion

•382 children went on trip, **155** symptoms (41%). i.e. **possible cases**

•Isolates from **primary cases** (**37**/54) environmental & animal sampling (calves & env 3/7, goats 2/19) on the farm were confirmed as *Cryptosporidium parvum.*

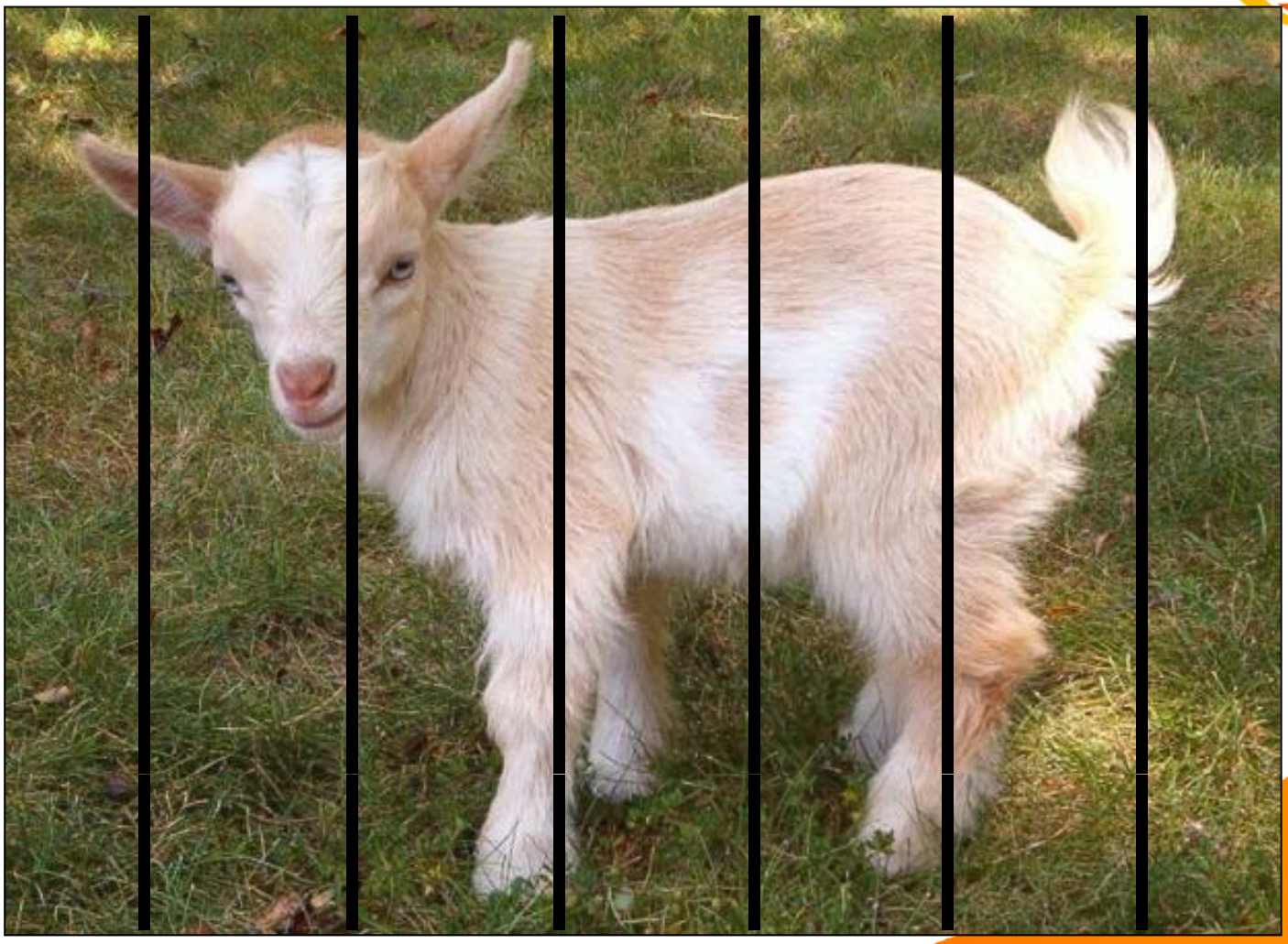
•Subtyping identified IIaA17G1R1 in the human samples, calf samples and goats.

•The **causative strain of the outbreak was *C.parvum* IIaA17G1R**, is a subtype linked to farm animal contact.

•The **reliance on alcohol hand gel** meant viable *Cryptosporidium* oocysts remained on the hands of the children after petting the animals. In a short space of time the children were then eating, providing further opportunity for transmission of infection.

•The epidemiological study suggests **petting and feeding goats** was the only exposure risk factor with statistically significant association with illness.

Health Protection Agency



Discussion

- *The epidemiological study suggests petting and feeding goats was the only exposure risk factor with statistically significant association with illness.*
- The use of alcohol hand gel (although very limited efficacy against *Cryptosporidium*) after petting the calves but not after petting & feeding goats, may have reduced the numbers of viable oocysts by dilution?
- The activity of feeding kid goats may present more exposure risks than petting alone?

Recommendations

Letter sent out to all schools in Cumbria & Lancashire highlighting:

•Schools should ensure the farm is aware of HSE guidance and has appropriate control measures in place including adequate hand washing facilities.

•Risk of infection and provision of adequate hand washing facilities must be covered by the schools health & safety risk assessment.

Recommended that the County Council Children's Services Health & Safety team review all risk assessments for farm visits before the event. Farm visits should be classed as potential high risk activities.

Current HSE/HPA guidance sent out to Agricultural Societies.

Summary

- Benefits of joint working between HPA, VLA, EHO, vets, local microbiology, National Cryptosporidium Reference Unit (Swansea)
- Strengths of epidemiological study in addition to microbiological detailed typing.
- Detection of outbreak at early stage and quick intervention prevented further secondary spread.

THANK YOU!

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